Energy Intake and Lean Growth in Growing-Finishing Pigs

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Introduction

As lean growth potentials in growing-finishing pigs continue to improve, through genetic selection and better health management, energy intake is more likely to become the limiting factor for lean growth up to higher body weights. Three recent studies indicate that in pigs with high genetic capacities for lean growth, energy intake limits lean growth up to at least 80 to 90 kg body weight (Campbell and Taverner, 1988; Rao and McCracken, 1991; Bikker, 1994). These observations have various implications. It will increase the need to: (1) characterize the relationship between energy intake and lean growth in the various populations of grower-finisher pigs; and (2) monitor and manipulate energy intake to optimize performance and profitability.

Both of these aspects are important. The level of energy intake at which lean growth is just maximized is the level of energy intake at which feed efficiency and caracass quality is optimized. As long as energy intake limits lean growth, energy intake should be maximized.

Characterization of the Relationship Between Energy Intake and Lean Growth

In Figure 1 the relationship between energy intake and lean growth is presented for growing pigs at a given body weight range. It is generally accepted that lean growth increases linearly (as a straight line) as energy intake increases until the pig's maximum capacity for lean growth is achieved. If energy intake exceeds energy requirements to just maximize lean growth, a further increase in energy intake does not affect lean growth rate and all the additional energy intake is used for (excessive) fat deposition. The amount of energy required to increase lean growth rate by one unit (say 100 g/d) is a relfection of the amount of energy required to produce this 100 g of lean AND the amount of fat that pigs must deposit as lean growth increases. In other words, growing pigs have to deposit a minimum amount of *(essential)* body fat even if energy intake is below what is required to maximize lean growth. At this time this need to deposit essential body fat is ill defined for the various populations of pigs. However, the limited amount of information that has been collected so far, suggests that there is a tremendous amount of variation in this performance trait. It is affected by pig genotype, sex and body weight. It is important to recognize that there is no clear relationship between the need to deposit essential body fat and lean growth potentials of pigs, i.e. pigs with the highest lean growth rates do not necessarily have the lowest requirements to deposit essential body fat. For example, the results of various studies summarized in Figure 2 indicate that the required energy intake over maintenance to achieve the same rate of lean growth varies considerably between the various pig types *(e.g. 19 vs 29 MJDE/d to deposit approximately 300 g/d of lean in LW x PP boars vs LWxLD boars of strain B).* It also indicates that the amount of required energy intake to just maximize lean growth may in some cases be similar for pigs that have different lean growth potentials (*e.g. approximately 300 g/d vs 200 g/d for LW x LD boars vs LW x LD castrates, strain B).*

The need to deposit essential body lipid increases with increasing body weight. In other words, growing pigs have to become fatter at increasing body weights, even if energy intake is below what is required to maximize lean growth. Finally, it should be noted that the relationship between energy intake and lean growth may be affected by the environment *(including health status)* and nutritional history as well.

Figure 1. General Relationship between Energy Intake and Lean Growth

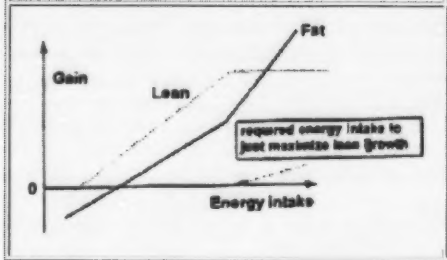
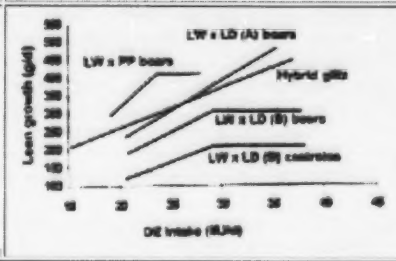


Figure 2. Relationship between Energy Intake and Lean Growth in Various Groups of Pigs (between 45 and 90 kg body weight; derived from Quiniou et at., 1995



Monitoring and Manipulating Energy Intake

Based on the limited amount of information that is available it can be suggested that energy intake is more likely to limit lean growth in finishing pigs than previously thought. This has some practical implications:

1. *A reduction in lean growth as pigs approach market weight is often attributed to the genotype (i.e. the pig type is attributed to early maturing) while it should be attributed to insufficient energy intake.* As mentioned earlier, the need for body fat deposition increases rapidly at increasing body weights in most lines of pigs. This means that pigs require considerably more energy to deposit the same amount of lean during the (late) finisher phase than during the grower phase. This, in turn, implies that energy intake, and not the pig's lean growth potential, may limit lean growth both during the grower phase and during the period just before slaughter. Under practical conditions this (*rapid*) reduction in growth rate just prior to slaughter is routinely observed, especially when feed intake is low (*high environmental temperature; summer months*).
2. Not enough emphasis is placed on maintaining sufficient levels of energy intake during the finisher phase. The many factors that affect feed intake are discussed elsewhere (de Lange, 1995; 2nd Edition of the Swine Nutrition Guide, 1995). In particular, environmental temperature should be controlled. The effect of environmental temperature on feed intake is much more dramatic than the effect of increased animal density. An increase in environmental temperature of only 1° C is equivalent to reducing floor space allowance by .1 m^2 (close to 1 ft^2) per pig !!!!
3. *Amino acid levels in the feed should be formulated based on amino acid to energy ratios rather than on daily intakes.* If you assume that energy intake does not limit lean growth, an increase in energy (or feed) intake should coincide with a reduction of amino acid levels in the diet (*or visa versa*) to ensure a constant daily amino acid intake. If, on the other hand you assume that energy intake is limiting lean growth, then the amino acid to energy ratio in the diet should be kept constant and the daily amino acid intake should be increased when energy (*feed*) intake increases. The optimum amino acid to energy ratio will vary with pig body weight and the minimum essential body lipid deposition to lean growth ratio.

The relationship between energy intake and lean grow this one of several arguments for monitoring energy (*feed*) intake. Other arguments include: the large variation in feed intake between farms, the use of feed intake as a quick and reliable indicator of potential problems in the grower-finisher barn, and the need to get estimates of feed intake for the development of effective feeding programs. Various means to monitor feed intake are discussed elsewhere (*de Lange, 1995; 2nd issue of the Swine Nutrition Guide, 1995*).

One recent study related to feed intake deserves further attention. A study at Purdue University (*Schinckel, 1994*) clearly demonstrates the large effects of pig genotype on voluntary feed intake. In feeder pigs managed under the same conditions and fed similar diets, observed differences in feed intake between the various lines of pigs were as high as 20-30%. Pigs selected for (*lean*) feed efficiency, rather than for lean growth rates, may have lower feed intake capacities as compared to the unselected controls. The results also indicate that the difference in feed intake between barrows and gilts is not the same for all genotypes: for one genotype it was 12% while for another genotype it was only 3%. This clearly demonstrates that it is too simple to assume there is one specific feed intake curve that can be used as a target intake curve for the different types of pigs and pig production units.

Conclusions

Various recent studies indicate that energy intake may limit lean growth in modern improved pig genotypes up to body weights of 80 kg and higher. This suggests it will become increasingly important to characterize the relationship between energy intake and lean growth at vaious body weight ranges and for different types of pigs. It also stresses again the need to monitor and manipulate feed intake, in particular in finishing pigs. At the University of Guelph a research program is in place to develop methodology to determine the effect of energy intake on lean growth in various pig types and at various body weights, and to determine the effect of energy intake on amino acid requirements.

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